proper motion a term p^1 has to be added to P, the value of which tends to 0″·48 as the magnitude, and the proper motion increases. So long ago as 1872, Prof. Gyldén showed that it is justifiable to deduce the distance of a group of stars from their apparent mean brightness in all cases where the probability of a certain intensity of illuminating power is a function of this intensity alone, without depending upon position in space. And since the photometric law has been proved to be at least approximately valid in this case, it may be concluded that the brightnesses of stars reduced to the same distance are the same, on an average, for all distances which can enter into our consideration. But the most important result of the present investigation is the determination of the mean parallax of first magnitude stars reduced to the zero of apparent motion. The value for this, which is 0″·204, may be considered as identical with Peters's value of 0″·209, especially when it is borne in mind that the latter value is not reduced to zero apparent motion.

THE INSTITUTION OF MECHANICAL ENGINEERS.

ON Wednesday and Thursday evenings of last week, October 24 and 25, a general meeting of the Institution of Mechanical Engineers was held at 25 Great George Street; the President, Prof. Alexander B. W. Kennedy, occupying the chair. The two following papers were read and discussed :

"The Manufacture of Standard Screws for Machine-made Watches," by Mr. Charles J. Hewitt, of Prescot.

"Drilling Machines for Cylindrical Boiler Shells," by Mr. Samuel Dixon, of Manchester.

Mr. Hewitt's paper was of an interesting nature. He is the works manager and chief mechanic of the Lancashire Watch Factory, an establishment recently started at Prescot for the manufacture of watches on a large scale in one works. The factory system of watch production has been, as is well known, carried to a very successful issue in the United States, where the Elgin and Waltham Watch Companies annually make large numbers of excellent time-pieces wholly by machinery. As, in all cases, where highly skilled hand labour, performing intricate operations, is superseded by mechanical appliances, the machines used are of a highly organised and costly nature. In the case of the minute parts required in watch-making, this feature is very strikingly emphasised. Perhaps some of our readers may remember the exquisite little machine tools exhibited by the Waltham Watch Company, at the Inventions Exhibition, in the year 1885. These were a revelation to most English watchmakers, accustomed to the small factories and perfectly rude appliances of the British industry, in which the highest skill of the operators, due to special training from earliest youth, compensated for the lack of ingenuity displayed in the construction of the tools used. In the case of watches, as with so many other mechanical productions, the brain capital expended in the employment of construction of machines bears fruitful interest in the shape of less skilled labour required in their use. The same thing may be observed throughout the whole range of mechanical industry. The file, the hammer, and chisel are the primitive tools of the engineer, requiring simple inventive power in their inception, but great skill in their use. The planing machine, by which the same end is obtained mechanically, of producing a flat surface, as was got originally by chipping and filing, required knowledge and skill for its production, but a comparatively small amount of those qualities for its operation. The same thing is true, even to a greater extent, in the case of the still more modern machine tool, the milling machine, which is often attended by boys, possessing no mechanical knowledge whatever, during its production of finished forms such as would have required a highly skilled workman in former days.

The beautiful machines referred to by the author in his paper, examples of which were shown at the meetings, carry the same principle many steps farther. As was remarked, the machine shown for making watch-screws may be said to stand in the same relation to ordinary engineers' machine tools as costly gems to common building stones.

Mr. Hewitt commenced his description by dwelling upon the difficulties experienced by watchmakers in old times, when there was no general standard for dimensions and pitch of screws, or form of thread. Such was necessarily the case with hand-work, but a machine can be depended upon to turn out many thousands of parts exactly similar, so that a screw could be put into a watch made years previously. The advantage, naturally, is most apparent in the case of repairs and renewals. The standard of screws adopted by the Lancashire Watch Company at their Prescot Works, is that recommended by the committee of the British Association, and described in the report of 1882. It is a V-thread of 47½ degrees, rounded top and bottom through $\frac{2}{11}$ of the height, and the pitch is directly related to the diameter of the formula $D = 6P^{\frac{6}{5}}$. In arranging the standard the first business was to make master taps, which were produced on a small screw-cutting lathe specially designed for the work, and having a corrected screw, accurate within very close limits. Taps being thus produced, screw-dies were made to the exact standard. When cut the thread requires hardening, and this causes some amount of distortion, which is corrected by grinding the threads with a soft steel lap charged with diamond dust, the operation being performed in the same lathe that cuts the thread. The die used is simply a tapped hole in the centre of a small thin disc of steel, it being an object to have as little metal as possible surrounding the hole, so as to reduce the distortion produced by hardening. Although the die is not split, the pressure exerted by the die-holder is sufficient to produce a slight modification in the diameter of the screw, and in this way the alteration caused by hardening is corrected. During the discussion this fact was questioned, but Mr. Hewitt says that the statement is absolutely correct. The machine itself is of an intricate design, as may be imagined when it is stated that perfect screws are turned out automatically from the plain rod or wire. There are four hollow spindles through which this wire is fed forward to the operating tools, which are four in number, and are carried on a revolving turret. There is also a further tool for making the slit in the screw-head for the turn-screw. It would be useless to attempt to describe the mechanism of this very ingenious lathe without the aid of elaborate drawings. Indeed, during the discussion several engineers, well skilled in mechanical appliances, confessed themselves unable to follow the train of mechanism, even with the aid of working drawings displayed on the walls of the theatre. It is enough to say that the machine will go on without any attention so long as the wire to form the screw lasts, when it stops of itself.

A short discussion followed the reading of the paper, but no fresh points were raised ; the speakers, for the most part, contenting themselves with complimenting the author on the ingenuity of his design.

On the second evening of the meeting, Mr. Dixon's paper, on drilling machines for boiler shells, was read and discussed. The introduction of steel as a material for steam-boiler construction opened up a new era in that branch of industry. When iron plates only were used, a first-class boiler-shop possessed, as the chief part of its plant, simply a punching machine and a pair of rolls for bending the plates ; the rest was done by handwork, and that of a highly skilled nature. Now that machinery has superseded the handicraftsman, rivetting is done by most costly and beautifully designed hydraulic apparatus, necessitating in its invention a knowledge of applied science of a high order. Flanging of the immense boiler-plates of the present day is also effected by heavy hydraulic presses. The rolls now used for bending plates have to be designed on true mechanical principles, whilst great advance has been made in drilling machinery. Thus both in the enormous boilers of our large steamships and in the diminutive mechanism of watches, we see the skilled handicraftsman being displaced by automatic machinery. It was soon found impossible to make steel boilers with the same plant that was used for the old type of iron boilers ; the difference in the physical properties of the material alone demanded a change in treatment. The softer and less homogeneous iron enabled the rivet-holes to be punched, but it was found that this work done upon steel plates caused a deterioration of the metal ; drilling, therefore, had to be substituted for punching. Iron plates were punched in the flat ; but it was found that with steel when the holes were made in that way, they often would not go together accurately so as to take the rivets to the greatest advantage, the result being a weak joint. This did not matter so much when steam pressures were low, but with the greater demands made by the marine engineer in producing motive power economically, higher pressures had to be used, and there was no margin for loss in the line of rivetting. It therefore became customary to bend the plates and put them into shape to form the shell of the

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boiler before making the holes, which were then drilled in position, and were necessarily true. This procedure involved the use of special drilling machines, whilst economy demanded that several drills should work at once in one machine so as to save time and be under the care of only one attendant. The chief object of Mr. Dixon's paper was to describe the most recent of these machines. The drill spindles are carried on supports which bring them to the work, and are adjustable to the varying pitches and angles required. There is a cross-slide which can be raised or lowered for carrying the drills for the circular seams, and this is adjustable so as to suit the varying threads required. There are five drills for this purpose, whilst six more are arranged upon a vertical column upon the opposite side of the boiler shell for operating upon the butt seams. One of the chief difficulties in drilling holes in a built-up shell is the flexibility of the work, which causes it to give way and buckle when the pressure of the drills is brought upon it. So great has been this drawback that it has been found more advisable in many cases to use only one drill at a time, although there may have been four spindles on the machine. Mr. Dixon has overcome this objection in an ingenious manner by an internal support which gives great rigidity to the shell, and enables the larger number of drills to be brought into play at once without their accumulated pressure causing deflection. During the discussion an interesting point arose in connection with this feature. It was said that twist drills which, when properly ground, gave very clean holes and great accuracy of work, could not be used on boiler shells, as they so frequently broke in work. The author said this was perfectly true in ordinary cases, but it was due to the springing of the shell referred to. The statement is corroborated by the fact that twist drills can be advantageously employed on work firmly held on the drilling machine-table, whereas the older form of flat drill would have to be used where rigidity could not be obtained.

A NEW METHOD OF PREPARING PHOSPHORETTED HYDROGEN.

A NEW and extremely simple mode of preparing phosphoretted hydrogen is described by Prof. Retgers in the current *Zeitschrift für Anorganische Chemie.* After reviewing the usual mode of preparing the gas for demonstration purposes, by heating yellow phosphorus in an aqueous solution of potassium hydrate, and the other more rarely employed methods of preparation—such as by the interaction of calcium phosphide and hydrochloric acid, copper phosphide and potassium cyanide, and phosphonium iodide and water—the question of the direct combination of hydrogen and phosphorus is discussed. It appears that the currently accepted idea that ordinary molecular hydrogen does not combine with phosphorus is founded upon some old experiments of the French chemists Fourcroy and Vauquelin, who state that when phosphorus is melted in hydrogen gas, vapour of phosphorus becomes diffused in the hydrogen, and confers upon it the power of ignition in contact with oxygen without any combination between the phosphorus and hydrogen occurring. In view of the great readiness which, as Prof. Retgers has recently shown, warm hydrogen exhibits to unite with free arsenic, it was considered possible that the reason for the non-combination of hydrogen and melted phosphorus might be found in the low melting-point (44°) of the latter. Experiments were therefore made with red phosphorus, which, of course, is capable of being raised to a much higher temperature. When dry hydrogen is led through a glass tube containing red phosphorus, and afterwards through a wash-bottle containing water, practically pure hydrogen is found to escape. Immediately, however, a gas flame is brought under the part of the tube containing the phosphorus, combination occurs, and the gas issuing from the wash-bottle at once inflames in the air. The non-spontaneously inflammable gaseous hydride of phosphorus is also therefore accompanied by a smaller quantity of the spontaneously inflammable liquid hydride, and a sufficient quantity of the latter for demonstration may be isolated by leading the vapours through a U-tube immersed in a freezing mixture. Moreover, the solid hydride is likewise produced as a yellow deposit near the heated portion of the tube. Upon removing the flame from beneath the tube, the bubbles of escaping gas cease to take fire as they emerge into the air, and are found to consist of almost pure hydrogen. The production of phosphoretted hydrogen is consequently entirely dependent upon the elevation of the temperature considerably above the melting point of ordinary yellow phosphorus. The new mode of preparation is recommended by Prof. Retgers as being more convenient and elegant than the old-established method of boiling phosphorus in caustic potash, as forming an excellent example of the direct combination of two elements, and as furnishing ample demonstration of all three hydrides of phosphorus, the gaseous, liquid, and solid.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Rolleston Memorial Prize has been awarded to M. S. Pembrey, of Christ Church, and E. S. Goodrich, of Merton College, the papers sent in by these two candidates having been judged to be equal. Mr. Pembrey was placed in the first class in the Honour School of Natural Science in 1889, and is demonstrator in the Physiological Department. Mr. Goodrich is still an undergraduate, and is assistant to the Linacre Professor. At a meeting of the Junior Scientific Club, held on Friday, October 26, Mr. W. J. Waterhouse, of Christ Church, exhibited some telephone cables, and Mr. W. P. Pycraft exhibited some Natterjack toads. Papers were read by Mr. W. Garstang, of Lincoln College, on some modifications of the Tunicate pharynx induced by the violent ejection of water, and by Mr. C. T. Blanshard, of Queen's College, on the genesis of the elements.

Sir Henry W. Acland, K.C.B., has announced his resignation of the Regius Professor of Medicine, the resignation to take effect at the end of the present year. Sir Henry is now in his eightieth year, and has long been a leading figure in scientific and medical matters in the University. His resignation will sever the link of many old associations. He has consistently and bravely supported the cause of science in Oxford, and that, too, at a time when scientific studies were regarded in anything but a favourable light by the rest of the University. It was largely due to his influence and energy that the University Museum was built, and he has never failed to support any movements for its further extension and for the improvement of the teaching which is carried on there. One of his latest efforts secured the building of the new Department of Human Anatomy, and he has had the satisfaction of seeing the medical school for which he worked so hard rise from almost nothingness into considerable dimensions, with every prospect of steady and healthy increase. He will carry with him on his retirement the affection and good wishes of all sections of the University.

SCIENTIFIC SERIALS.

IN the *Nuovo Giornale Botanico Italiano* for October, Sigg. G. Del Guercio and E. Baroni describe the disease of Italian vines caused by a Schizomycete, and known as *gommosi bacillare* or *gelivure.*—Sig. C. Massalonga describes a large number of abnormal growths in different plants.—All the other papers concern the local Italian flora.

IN the *Journal of Botany* for August, September, and October, Mr. F. J. Hanbury adds seven more to the interminable list of new species of *Hieracium.*—Rev. E. S. Marshall describes and figures an apparently new species of *Cochlearia, C. micacea,* from Ben Lawers.—Messrs. J. G. and E. G. Baker discuss the botany of an interesting corner of Westmoreland, High-cup Nick.—The Ericaceæ and the Asclepiadeæ of South Africa are treated of, respectively, by Mr. H. Bolus and Mr. R. Schlechter.—Students of the local distribution of plants in Great Britain will find other papers to interest them.

Symons's Monthly Meteorological Magazine, October.—Protection from lightning, by A. McAdie. This is a summary of one of the Circulars of Information issued by the Weather Bureau, Washington. In addition to a number of rules for erecting lightning rods, the pamphlet contains statistical tables of injury to life and property by lightning in the United States. Full recognition is given by the author of the Report of the Lightning Rod Conference published in 1882, and of the experiments made by Prof. Oliver Lodge.—The recent drought in the Midlands, by the Rev. G. T. Ryves. During 26 days ending September 21, only 0·06 inch of rain fell at Tean Vicarage. Mr. Symons shows that at Barkby, Leicestershire, 1·10 inch of rain fell. The same record shows that the first nine months of

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